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IN THE MATTER OF
United States Patent Application No. 09/889537

EXHIBIT A as mentioned in the Declaration of Professor Lucas

dated 12 MARCH 2004

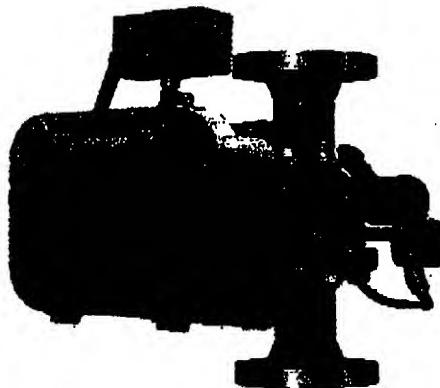


AGAR CORPORATION

Process Measurement & Control



AGAR OW-201 OIL/WATER - WATERCUT MONITOR LIQUID/LIQUID CONCENTRATION MONITOR



Description

The AGAR OW-201 oil/water or watercut monitor measures liquid-in-liquid concentrations using microwave absorption technology. The OW-201 series is the second generation microwave based oil/water monitor designed after the first 0-100% oil/water monitor introduced to the market over fifteen years ago.

The monitor utilizes a microwave transmitter (2.45 Gigahertz) and two receivers that measure bulk electrical properties of the flowstream. These properties are analyzed and translated into volumetric concentrations.

The monitor can measure hydrocarbon/water mixtures over the full range of 0-100%, regardless of the continuous phase. The OW-201 monitor is available in a variety of ranges, from 0-1% to 0-100% and in sizes 2", 3" and 4".

The accuracy of the measurement is not affected by the salinity, density, viscosity, temperature or velocity of the components being analyzed. Typical applications include finished products, water in produced oil, oil in the waste water process, on-line analysis of alcohol content in aqueous/organic measurement.

A high temperature version of the OW-201 has been developed for the SAGD-projects in Canada. These units perform in process

temperatures up to 450°F (232°C), measure changes in salinity and automatically compensate calibration.

System Configuration

The OW-201 system consists of the OW-201 sensor, the microwave measurement electronics, and Data Analysis System (DAS) which can be remotely located up to 3,000 ft. from the sensor. The sensor is a flanged spool assembly which houses the microwave transmitting and receiving antennas. The integral spool mounted measurement electronics are supplied in an explosion proof enclosure, and provide the intrinsically safe microwave signal inputs/outputs to the antennas.

The DAS is also a flow computer which can provide net oil, net water and total flow when customer flow meter input is supplied. Options for the DAS include a regular desktop PC or an industrial computer. The industrial computer is available housed inside a weather proof or an explosion proof enclosure for mounting in appropriate areas. The data from the sensor is transmitted to the DAS via an RS-422 communication channel.



All AGAR Corporation Instruments are covered by one or more of the following U.S. Patents: 4,503,383; 4,774,680; 5,099,697; 5,101,163; 5,101,367; 5,263,363; 5,503,004; 5,551,305; 5,589,642; 5,741,977, RE 36,597, and other patents pending in the USA and other countries.

MEASUREMENT CAPABILITIES & ACCURACY

Model	Range*	Absolute Accuracy	Repeatability
OW-201-01	0 to 1%	±0.01%	±0.1
OW-201-10	0 to 10%	±0.1%	±0.1
OW-201-100	0 to 100%	±1%	±0.1

* Water concentration. Contact factory for additional range options.

PHYSICAL DIMENSIONS

Model	Pipe Diameter	Overall Length
OW-201	2"	27.0"
OW-201	3"	27.75"
OW-201	4"	27.75"

Typical dimensions for a standard OW-201 0-100%, 8000 unit.
Contact factory for other dimensions.

PROCESS CONDITIONS

Ambient Temperature: -4°F to 140°F (-20°C to 60°C) (Optional -40°F/C)
 Process Temperature: Standard Model 32°F to 200°F (0°C to 93°C)
 High Temperature Model 32°F to 450°F (0°C to 232°C)
 Salinity: 0 to 30% by weight (conductivity of up to 18 S/m)
 Wetted Parts: Carbon or Stainless Steel; Peek; Kalrez
 Design Pressure:

ANSI CLASS	PSIG*	BARS
150#	275	20
300#	720	50
600#	1440	100
900#	2160	150
1500#	3600	200

For higher ratings contact factory.

Carbon steel at 100°F.

POWER SUPPLY

100/240 VAC, 50 or 60 Hz or 12/24 VDC

Power Requirements: 34 Watts (100/240 VAC) or 24 Watts (12/24 VDC)

SAFETY CERTIFICATION

CENELEC - EEx ia IIC T6

UL/C-UL - Class1, Division 1, Group C&D, T6

ATEX - Approval effective June 1, 2003

DATA OUTPUT/INPUT

STANDARD:

- Output Data: Oil/water concentration, error status, and temperature standard.
- Input Data: Flow; 1 pulse (0-5 to 0-30 V <2KHz) or 1 analog (4-20 mA)
- User Communication: RS-232, Protocol: Standard N/C - ASCII or Modicon Modbus.

OPTIONS:

- Hand held terminal with digital display. Only available for remote DAS.
- If customer's flow meter input provided, Net Oil, Net Water, and Flow Rates are calculated.
- Outputs: 2 - Analog : 1-5 VDC, 2-10 VDC or 4-20 mA, HART option
 3 - Pulse : SPST relay or opto-isolated AC/DC switch output
 1 - Relay Trip: 1 (SPST relay or opto-isolated AC/DC switch output)
- User Communication : Modem, RS-422, Hand Held Terminal

The Agar Oil/Water Monitor measures percent water through measurement of certain electrical properties of the hydrocarbon/water mixture. There are other constituents in such oil/water mixtures (such as sulfur, iron sulfide/oxide, etc.) that absorb electromagnetic energy at a rate that is equal to or even greater than that of water. When these interfering constituents are present and their content varies, the resultant change in composition of the oil/water mixture can cause a baseline shift in the energy absorption. The shift will be seen as variations in the measured percent water. This shift can be corrected with automatic instrumentation/algorithm (e.g. densitometer or sulfur analyzer) input or by manual adjustment of the OW-201's zero setting. In either case, prior knowledge of the interfering parameters and their variation will allow for most accurate measurement.

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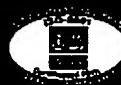
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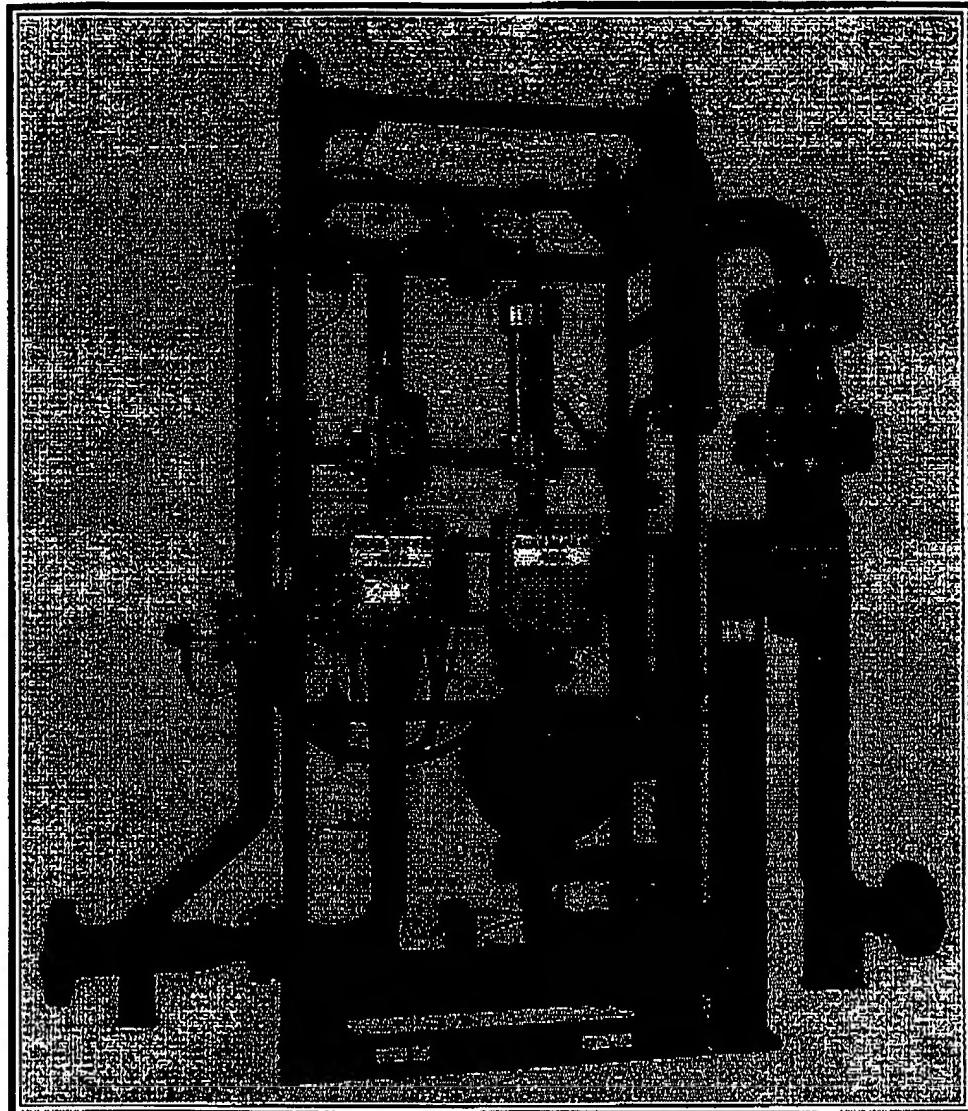


AGAR CORPORATION

Process Measurement & Control



AGAR MPFM-400 SERIES MULTIPHASE FLOW METER



• FOR HIGH VOID FRACTIONS • HIGH GAS TO LIQUID RATIO •
SURGING FLOW CONDITIONS

EXTENDS THE DYNAMIC RANGE AND GAS HANDLING CAPABILITIES OF
THE MULTIPHASE FLOW METER

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5,101,367; 5,263,363; 5,303,004; 5,551,305; 5,589,642; 5,741,977, RE 36,597, and other patents pending in the USA and other countries.

AGAR MPFM-400 SERIES MULTIPHASE FLOW METER

Description

The AGAR MPFM-400 Series Meters (patents pending) are designed to handle a wide range of flow rates and gas-to-liquid ratios in all flow patterns where the liquid phase is saturated with gas at the point of measurement.

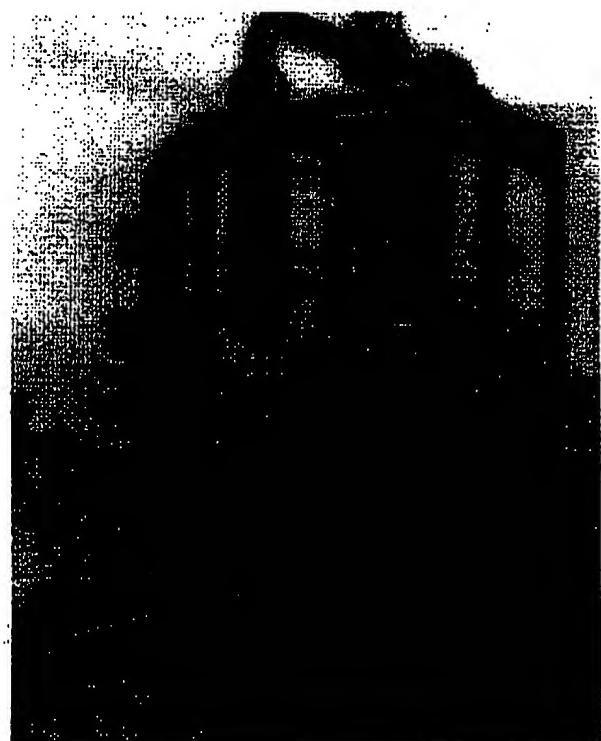
The AGAR MPFM-400 Series extends the dynamic range of the gas and void fraction capacity of the patented AGAR MPFM-300 Series multiphase flow meters (see MPFM-300 Series specification) by adding a Fluidic Flow Diverter (FFD[®]) Device and gas bypass loop.

The FFD[®] Device uses the difference in flow momentum of the gas and the liquid to divert most of the free gas in the stream into a secondary measurement loop around the core MPFM-300 . The remaining fluids flow through the core MPFM-300 Series system. The gas in the bypass loop is metered and added to the oil, water and gas discharged from the MPFM-300 core unit.



By reducing the amount of gas flowing through the MPFM-300 Series core unit, the MPFM-400 Series often allows the use of smaller MPFM-300 units. This arrangement can reduce the cost of measuring flow streams where gas is the dominant component of the flow.

The extended dynamic range of gas measurement in the MPFM-400 Series meters makes them very suitable for multiphase well testing in wells with very high GOR or wells with moderate GOR that are tested at low pressure.



*MPFM-400 Installation on an Offshore Platform.
Application - Well Testing in a Gas-Lift Operation; 99% GVF.*

GENERAL SPECIFICATIONS OF THE AGAR MPPM-400 SERIES METER:
Process Conditions:

Instantaneous Void Fraction	:	0 to 99.6%
Watercut	:	0 to 100%
Flow Patterns	:	All: (e.g. Bubbly, Wavy, Slug, Annular flows, etc.)
Pressure	:	Up to 10,000PSI / 680 BARS
Ambient Temperature	:	-40°C to 70°C (-40°F to 160°F)
Process Temperature	:	15°C to 93°C (60°F to 200°F) *Optional High-Temp (15°C to 232°C / 60°F to 450°F)
Viscosity	:	.5 to 100 Centipoise (Higher viscosity optional)
Salinity	:	0 to 20% by weight
Sand/Particulate	:	Up to 5% by volume
Max. Pressure Drop	:	Less than 15 PSI (1 bar)
Wetted Parts	:	Stainless Steel; Teflon; Ceramic, Elastomer, PEEK.

Typical Dimensions: (ANSI 300*)

Model	Weight		Dimensions	
	(Lbs.)	(Kg.)	(Inches)	(Centimeters)
401-10-10	2,300	990	62X30X80	159X77X205
401-20-20	3,000	1,365	84X34X90	215X87X230
401-30-30	4,000	1,820	100X40X120	256X102X307
401-40-40	5,000	2,270	120X48X144	307X123X369

*Weights and dimensions will vary for different gas loop options.

Electrical:

Power Supply: 110, 220 VAC or 12, 24 VDC (optional)
Power Requirements: 36 Watts with pneumatic actuator

Safety Certifications:

CENELEC - EEx ia IIC T6
UL/C-UL - Class 1, Division 1, Group C & D, T4

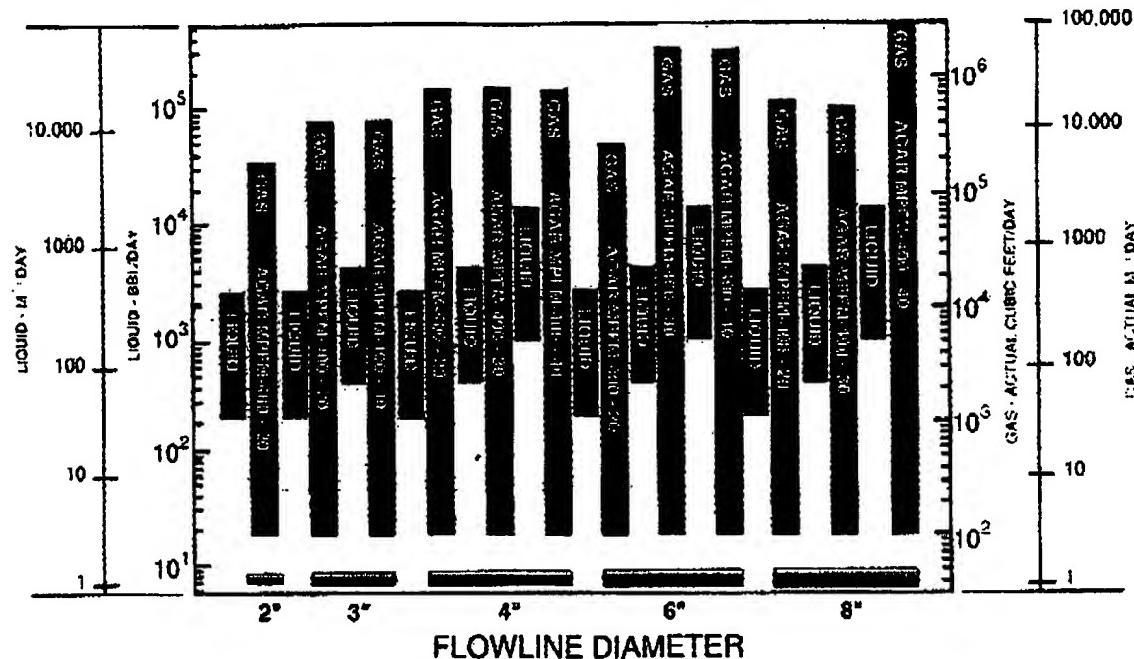
Data Communication (Standard and Optional):

Standard:	Keyboard & LCD Screen
Standard:	Text (Screen, File, Printer) indicating temperature, pressure, volumetric flow rate of gas, oil, water, and total flow.
Standard:	Graphics (Screen) indicating time trending and bar graphs of gas, oil and water flow rates, temperature, and pressure.
Standard:	One RS232 and one RS485 outputs, MODBUS and ASCII protocol. Other types optional.
Standard:	Hard Disk, Floppy.
Optional:	Analog output card to handle up to 6 outputs: 4-20 mA / 1-5V / Relay / Pulse Outputs / 0-5 VDC / 0-10 VDC, or a combination of the above
Optional:	Analog Input Card

Mod Is and Capacity

The bypass gas measurement loops are available in different standard sizes, any of which is added to a standard MPFM-300 Series unit to complete an MPFM-400 Series unit. The size of the MPFM-300 used in the 400 model is based on the required liquid measurement capacity.

The following chart shows the MPFM-400 Series meter necessary to handle flow rates for different flow line sizes and gas to liquid ratios.



Accuracy of the MPFM-400 Series:

Accuracies are not affected by changes in salinity, viscosity, density, temperature, pressure or pH. Since the MPFM-400 Series uses the MPFM-300 Series for core multiphase measurements, its accuracy is dictated by the accuracy of the MPFM-300 as shown in the following table:

MPFM-300 Series	± 2% of full scale, plus ± 5% of reading
MPFM-400 Series	± 2% of full scale, plus ± 5% of reading
Stem Flow Ringers	± 5% of full scale*, plus ± 5% of reading

*Full scale depends on the size of the MPFM-400 Series bypass loop.



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AGAR CORPORATION

Process Measurement & Control



AGAR MPFM-300 SERIES MULTIPHASE FLOW METER (OIL/WATER/GAS)



*MPFM-300 Installation - Application - Well Testing
and Diluent Optimization at high viscosity operation*



MPFM-300 Installation on an Offshore Platform

The AGAR MPFM-300 Series is a true multiphase flow meter that provides on-line, real-time well production information for oil, water and gas flow rates, without separation of the phases. No longer is there a need for expensive, secondary equipment such as phase separators and pumps. The MPFM-300 Series is fully self-contained and compact for use in rugged field conditions.

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Features of the AGAR MPFM-300 Series:

The AGAR MPFM-300 Series Multiphase Flow Meter provides accurate measurements of oil/gas/water flowing simultaneously, without physically separating the phases. AGAR Corporation's patented technology achieves unprecedented accuracy in multiphase measurements. The system can be used in all flow patterns with both oil-continuous and water-continuous fluid streams. The MPFM-300 Series is specially designed for low maintenance and ease of operation. No field calibration or prior knowledge of the fluid properties, such as density and salinity, is required to attain the specified accuracies.

Advantages of the AGAR MPFM-300 Series:

- ◆ Highly accurate, real-time flow measurement
- ◆ Self-verification capability in the field
- ◆ No nuclear (radioactive) sources
- ◆ Can be used in all flow patterns
- ◆ Requires little maintenance
- ◆ Compact, portable, and easy to transport and install
- ◆ Not affected by changes in fluid properties
- ◆ Measures in both oil- and water-continuous phases
- ◆ Gas void fraction 0-97%

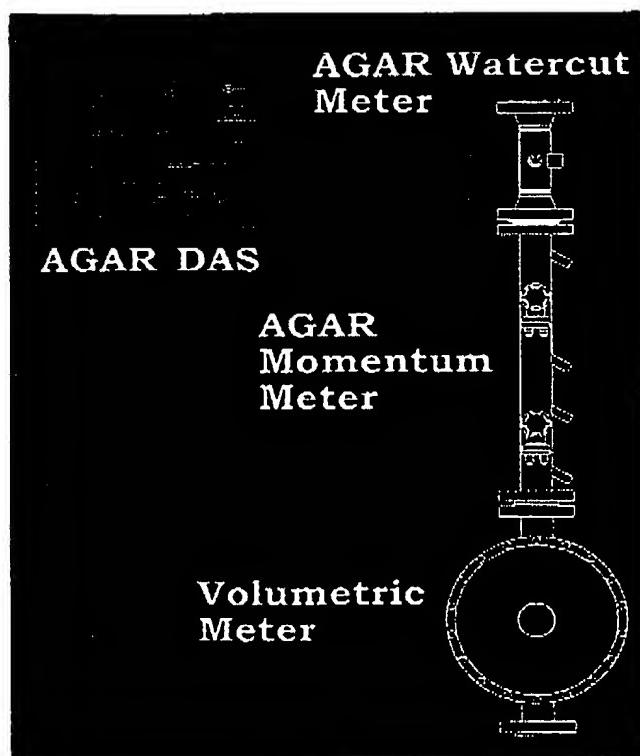
Four Primary Sub-Systems Are Used to Achieve Accuracy:

The Volumetric Flow Meter is a positive displacement meter that accurately measures the total flow (gas and liquid). This meter is selected from a range of commercially available products with proven field records. The volumetric flow data is fed into the MPFM Data Analysis System (DAS) which performs calculations for the multiphase measurement.

The AGAR Momentum Meter uses a unique venturi configuration to establish the gas volume fraction of the flow stream. Data from the momentum meter is fed into the MPFM DAS.

The AGAR Watercut Meter (OW-201) is a microwave-based oil/water monitor. The OW-201 uses a microwave transmitter broadcasting at over 2 Gigahertz and receivers to measure bulk electrical properties of the fluid. Engineering advances allow the OW-201 to measure water content accurately over the full range of 0-100% in both oil and water-continuous phases. Accuracy is not affected by changes in velocity, salinity, pH, viscosity, temperature or density. Watercut data is fed into the MPFM DAS.

The AGAR Data Analysis System (DAS) performs on-line analysis of data acquired from the above subsystems to determine the oil, water, gas, and total fluid flow rates.



GENERAL SPECIFICATIONS OF THE AGAR MPFM-300 SERIES METER:

Process Conditions:

Instantaneous Void Fraction	:	0 to 97%
Watercut	:	0 to 100%
Flow Patterns	:	All: (e.g. Bubbly, Wavy, Slug, Annular flows, etc.)
Design Pressure	:	Up to 10,000PSI / 680 BARS
Ambient Temperature	:	-40°C to 70°C (-40°F to 160°F)
Process Temperature	:	15°C to 93°C (60°F to 200°F) *Optional High-Temp (15°C to 232°C / 60°F to 450°F)
Viscosity	:	.5 to 100 Centipoise (Higher viscosity optional)
Salinity	:	Up to 0 to 20% by weight
Sand/Particulate	:	Up to 5% by volume
Max. Pressure Drop	:	Less than 15 PSI (1 bar)
Corrosion Resistance	:	Standard NACE MR-01-75 Latest Edition
Wetted Parts	:	Stainless Steel; Carbon Steel; Teflon; Ceramic, PEEK.

Typical Dimensions: (ANSI 300, DOWN-LEG AND SKID-MOUNTED OPTIONS)

Model	Weight		Dimensions (F/FxWxH)	
	(Lbs.)	(Kg.)	(Inches)	(Centimeters)
301-10	1100	500	35X34X65	89X86X165
301-20	1500	690	44X34X90	111X86X223
301-30	2100	955	45X34X119	114X86X302
301-40	2600	1180	58X42X127	147X86X322

Electrical:

Power Supply: 110, 220 VAC or 12, 24 VDC (Optional)

Power Requirements: 36 Watts with pneumatic actuator

Safety Certifications:

CENELEC - EEx ia IIC T6

UL/C-UL - Class 1, Division 1, Group C & D, T4

Data Communication (Standard and Optional):

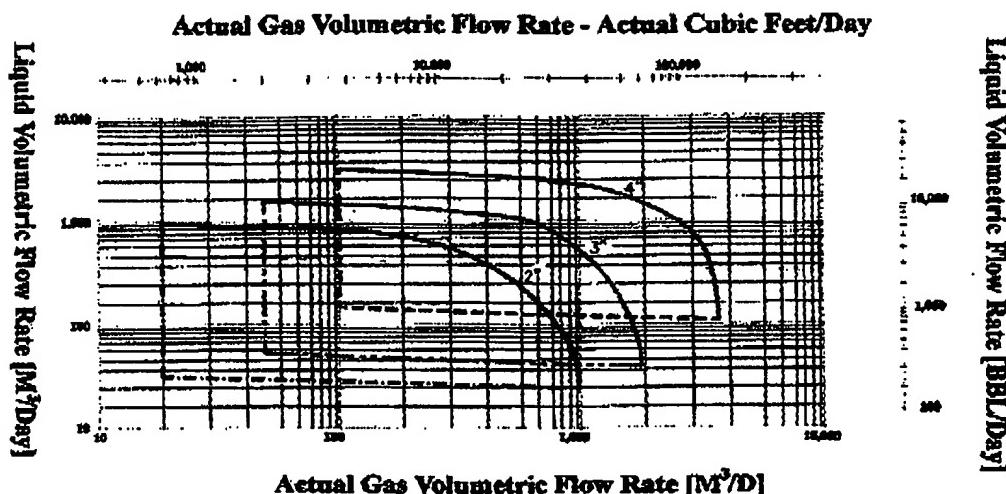
Standard:	Keyboard & Color Screen
Standard:	Text (Screen, File, Printer) indicating Temperature; Pressure; Volumetric Flow Rate of Gas, Oil, Water, and Total Flow.
Standard:	Graphics (Screen) indicating Time trending and bar graphs of gas, oil and water flow rates, temperature, and pressure.
Standard:	One RS232 and one RS485 outputs (baud rate up to 1115.2 Kbps), Modicon MODBUS and ASCII protocol. Other types optional.
Standard:	Hard Disk, Floppy Drive.
Optional:	Analog Output Card to handle up to 6 outputs: 4-20 mA / 1-5VDC / 2-10VDC / 0-5VDC / 0-10VDC / Relay / Pulse Outputs or a combination of the above
Optional:	Analog Input Card

Capacity of the AGAR MPFM-300 Serie :

MPFM Model* Number	8	240	50	1,500
	15	800	100	5,000
	50	1,600	300	10,000
	130	3,800	800	24,000

* Not all models and capacities are listed. Volumetric capacities are for .5 - 100 cP viscosity range. Capacities vary by viscosity, temperature, liquid/gas ratio, pressure and other factors. Contact Factory for specific application information.

This graph shows the effect of Gas to Liquid Ratio (GLR) on liquid capacity of the MPFM-300:



Accuracy of the AGAR MPFM-300 Series:

Accuracies are not affected by changes in salinity, viscosity, density, temperature, pressure, or pH.

Worst Case Instantaneous Errors (Quoted to 1 sigma):

MPFM-300 Model 8	± 2% of full scale, plus ± 5% of reading
MPFM-300 Model 15	± 2% of full scale, plus ± 5% of reading
MPFM-300 Model 50	± 5% of full scale, plus ± 5% of reading
MPFM-300 Model 130	± 2% of reading

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SPE 56585

Field Evaluation of Different Multiphase Flow Measurement Systems

P.G. Mohamed, SPE and K. H. Al-Saif, SPE, and A. Mohamed, Kuwait Oil Company

The paper was prepared for presentation at the 1995 SPE Annual Technical Conference and Exhibition held in Houston, Texas, 1-4 October 1995.

Restricted Abstract

Two multiphase flow meters (MPFM) working on different operating principles were tested (one at a time) in series with a conventional well testing system (test separators and a test tank) at an operating field in Kuwait. The first MPFM utilizes a fluid conditioner to separate the gas, which is measured by a vortex shedding flow meter. Liquid flow is measured with coriolis meter and the watercut is obtained by cyclic sampling and measurement of electrical characteristics and differential pressure between top and bottom of the sample chamber. The other MPFM employs a positive displacement meter, a venturimeter and microwave sensor to measure the flow to total fluid, gas and water respectively. A bypass loop with a vortex shedding flow meter enables measurement of a larger range of gas flow rate.

A number of wells covering a wide range of production rate (377 to 6661 bpd), gas oil ratio (207 to 945) and watercut (0-65%) were tested.

Introduction

While it is advantageous to avail the benefits of recent advancements, caution has to be exercised in choosing the right technology. Towards this, KOC entered into contracts with Hydralift WellComp (MPFM-X) and Agar Corporation (MPFM-Y) for the field trial of their MPFMs with the requirement to purchase their unit if it meets the mutually specifications. The paper describes the outcome of these field trials at a Gathering Center of KOC.

Special Observations

1. **Foaming:** Some of the wells tested had foaming tendency. The performance of the MPFM-Y showed no susceptibility to the foaming nature of the crude. However, foaming effect on MPFM-X was significant; antifoaming was required to mitigate the crude carryover in gas leg.
2. **Slinging:** MPFM-X results were more affected by sharp variations in flow.
3. **Operation Attention:** It was noticed that MPFM-X required more operator attention (post startup checks, monitoring chemical injection and carryover) than MPFM-Y.

Conclusions

1. There was no need for any input by operator on fluid properties such as density or salinity for MPFM-Y.

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SPE 56585 - Field Evaluations of Different Multiphase Flow Measurement Systems
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